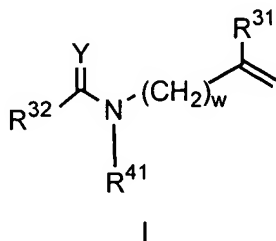


What is claimed is:

1. An antimicrobial lens comprising silver and a polymer formed from a reaction mixture comprising at least one ligand monomer of Formula I



wherein

- 10 w is 0-1;
 Y is oxygen or sulfur;
 R³¹ is hydrogen or C₁₋₆alkyl;
 R³² is selected from the group consisting of hydroxyl, amino, sulfonic
 acid, phosphonic acid, carboxylic acid, thioC₁₋₆alkylcarbonyl,
15 thioC₁₋₆alkylaminocarbonyl, -C(O)NH-(CH₂)_d-R³³, -O-R³³, -NH-R³³,
 -S-(CH₂)_d-R³³, -(CH₂)_d-R³³, C₁₋₆alkyldisulfide, phenyldisulfide, urea,
 C₁₋₆alkylurea, phenylurea, thiourea, C₁₋₆alkylthiourea, phenylthiourea,
 C₁₋₆alkylamine, phenylamine, substituted C₁₋₆alkyldisulfide, substituted
 phenyldisulfide, substituted phenylurea, substituted C₁₋₆alkylamine,
20 substituted phenylamine, substituted phenylthiourea, substituted
 C₁₋₆alkylurea or substituted C₁₋₆alkylthiourea wherein the substituents
 are selected from the group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl,
 halogen, hydroxyl, carboxylic acid, sulfonic acid, phosphonic acid,
 amine, amidine, acetamide, and nitrile

- 25 where

d is 0-8;
R³³ is thioC₁₋₆alkylcarbonyl, C₁₋₆alkyl, substituted C₁₋₆alkyl
where the alkyl substituents are selected from

one or more members of the group consisting of
 C₁₋₆alkyl, halo C₁₋₆alkyl, halogen, hydroxyl,
 carboxylic acid, sulfonic acid, phosphonic acid,
 amine, amidine, acetamide, nitrile, thiol,
 C₁₋₆alkyldisulfide, C₁₋₆alkylsulfide, phenyldisulfide,
 urea, C₁₋₆alkylurea, phenylurea, thiourea,
 C₁₋₆alkylthiourea, phenylthiourea, substituted
 C₁₋₆alkyldisulfide, substituted phenyldisulfide,
 substituted C₁₋₆alkylurea, substituted phenylurea,
 substituted C₁₋₆alkylthiourea or substituted
 phenylthiourea
 wherein the C₁₋₆alkyldisulfide, phenyldisulfide,
 C₁₋₆alkylurea, C₁₋₆alkylthiourea, phenylurea, and
 phenylthiourea substituents are selected from the
 group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl,
 halogen, hydroxyl, carboxylic acid, sulfonic acid,
 phosphonic acid, amine, amidine, acetamide, and
 nitrile;

$-(\text{CR}^{34}\text{R}^{35})_q-(\text{CHR}^{36})_m-\text{SO}_3\text{H}$
 where R³⁴, R³⁵, and R³⁶ are independently selected
 from the group consisting of hydrogen, halogen,
 hydroxyl, and C₁₋₆alkyl,
 q is 1-6, and m is 0-6;

$-(\text{CH}_2)_n-\text{S}-\text{S}-(\text{CH}_2)_x-\text{NH}-\text{C}(\text{O})\text{CR}^{37}\text{CH}_2$,
 where R³⁷ is hydrogen or C₁₋₆alkyl,
 n is 1-6, and x is 1-6;

$-(\text{CR}^{38}\text{R}^{39})_t-(\text{CHR}^{40})_u-\text{P}(\text{O})(\text{OH})_2$
 where R³⁸, R³⁹, and R⁴⁰ are independently selected
 from the group consisting of hydrogen, halogen,
 hydroxyl, and C₁₋₆alkyl,
 t is 1-6, and

u is 0-6;
phenyl, benzyl, pyridinyl, pyrimidinyl, pyrazinyl,
benzimidazolyl, benzothiazolyl, benzotriazolyl, naphthaloyl,
quinolinyl, indolyl, thiadiazolyl, triazolyl,
5 4-methylpiperidin-1-yl, 4-methylpiperazin-1-yl,
substituted phenyl, substituted benzyl,
substituted pyridinyl, substituted pyrimidinyl,
substituted pyrazinyl, substituted benzimidazolyl,
substituted benzothiazolyl, substituted benzotriazolyl,
10 substituted naphthaloyl, substituted quinolinyl,
substituted indolyl, substituted thiadiazolyl,
substituted triazolyl, substituted 4-methylpiperidin-1-yl, or
substituted 4-methylpiperazin-1-yl,
wherein the substituents are selected from one or more
15 members of the group consisting of C₁₋₆alkyl,
haloC₁₋₆alkyl, halogen, sulfonic acid, phosphonic acid,
hydroxyl, carboxylic acid, amine, amidine,
N-(2-aminopyrimidine)sulfonyl,
N-(aminopyridine)sulfonyl, N-(aminopyrazine)sulfonyl,
20 N-(2-aminopyrimidine)carbonyl,
N-(aminopyridine)carbonyl, N-(aminopyrazine)carbonyl,
N-(2-aminopyrimidine)phosphonyl,
N-(2-aminopyridine)phosphonyl,
N-(aminopyrazine)phosphonyl,
25 N-(aminobenzimidazolyl)sulfonyl,
N-(aminobenzothiazolyl)sulfonyl,
N-(aminobenzotriazolyl)sulfonyl,
N-(aminoindolyl)sulfonyl, N-(aminothiazolyl)sulfonyl,
N-(aminotriazolyl)sulfonyl,
30 N-(amino-4-methylpiperidinyl)sulfonyl,
N-(amino-4-methylpiperazinyl)sulfonyl,

N-(aminobenzimidazolyl)carbonyl,
 N-(aminobenzothiazolyl)carbonyl,
 N-(aminobenzotriazolyl)carbonyl,
 N-(aminoindolyl)carbonyl, N-(aminothiazolyl)carbonyl,
 5 N-(aminotriazolyl)carbonyl,
 N-(amino-4-methylpiperidinyl)carbonyl,
 N-(amino-4-methylpiperazinyl)carbonyl,
 N-(2-aminobenzimidazolyl)phosphonyl,
 N-(2-aminobenzothiazolyl)phosphonyl,
 10 N-(2-aminobenzotriazolyl)phosphonyl,
 N-(2-aminoindolyl)phosphonyl,
 N-(2-aminothiazolyl)phosphonyl,
 N-(2-aminotriazolyl)phosphonyl,
 N-(amino-4-methylpiperidinyl) phosphonyl,
 15 N-(amino-4-methylpiperazinyl) phosphonyl, acetamide,
 nitrile, thiol, C₁₋₆alkyldisulfide, C₁₋₆alkylsulfide, phenyl
 disulfide, urea, C₁₋₆alkylurea, phenylurea, thiourea,
 C₁₋₆alkylthiourea, phenylthiourea, substituted
 C₁₋₆alkyldisulfide, substituted phenyldisulfide,
 20 substituted C₁₋₆alkylurea, substituted C₁₋₆alkylthiourea,
 substituted phenylurea, and substituted phenylthiourea
 wherein the C₁₋₆alkyldisulfide, phenyldisulfide,
 C₁₋₆alkylurea, C₁₋₆alkylthiourea, phenylurea, and
 phenylthiourea substituents are selected from the
 25 group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl, halogen,
 hydroxyl, carboxylic acid, sulfonic acid, phosphonic
 acid, amine, amidine, acetamide, and nitrile;
 R⁴¹ is selected from the group consisting of hydrogen, C₁₋₆alkyl,
 phenyl, C₁₋₆alkylcarbonyl, phenylcarbonyl, substituted C₁₋₆alkyl,
 30 substituted phenyl, substituted C₁₋₆alkylcarbonyl and substituted
 phenylcarbonyl,

wherein

the substituents are selected from the group consisting of
C₁₋₆alkyl, haloC₁₋₆alkyl, halogen, hydroxyl, carboxylic acid,
sulfonic acid, phosphonic acid, amine, amidine, acetamide,
and nitrile

wherein the silver is releasably bound to the ligand, and the silver is present in
the lens in an amount, expressed as a ratio of silver to ligand monomer of at
least about 0.6.

2. The antimicrobial lens of claim 1 wherein,
w is 0-1;

R³¹ is hydrogen;

R³² is selected from the group consisting of amine, C₁₋₃alkylamine,
phenylamine, substituted phenylamine, thioC₁₋₃alkylcarbonyl; and

R⁴¹ is hydrogen

3. The antimicrobial lens of claim 1 wherein the lens is a soft contact lens.

4. The antimicrobial lens of claim 1 wherein the monomer of Formula I is
present at about 0.01 to about 1.5 weight percent.

5. The antimicrobial lens of claim 1 wherein the ligand monomer is present
at about 0.01 to about 0.8 weight percent.

6. The antimicrobial lens of claim 1 wherein the ligand monomer is present
at about 0.01 to about 0.3 weight percent.

7. The antimicrobial lens of claim 1 wherein the ligand monomer is present
at about 0.01 to about 0.2 weight percent.

8. The antimicrobial lens of claim 1 wherein the ratio of silver to ligand

monomer is at least about 0.8.

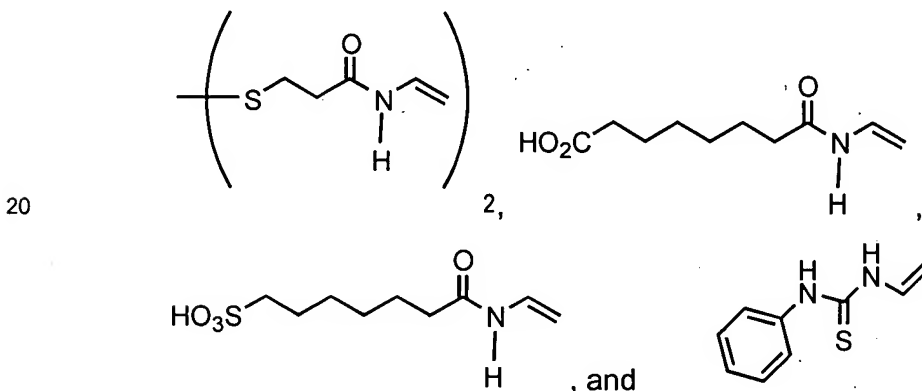
9. The antimicrobial lens of claim 1 wherein the lens is a silicone hydrogel.

5 10. The antimicrobial lens of claim 1 wherein, the lens is etafilcon A, balafilcon, A, aquafilcon A, lenefilcon A, galyfilcon, senofilcon or lotrafilcon A.

11. The antimicrobial lens of claim 1 wherein,

10 $R^1, R^4, R^5, R^6, R^8, R^9$ and R^{10} are independently hydrogen or methyl;
 R^2 is NH-R^3 ;
 R^3 is $-(\text{CR}^4 \text{R}^5)_q-(\text{CHR}^6)_m-\text{SO}_3\text{H}$, $-(\text{CR}^8 \text{R}^9)_t-(\text{CHR}^{10})_u-\text{P}(\text{O})(\text{OH})_2$ or
 $-(\text{CH}_2)_n-\text{S}-\text{S}-(\text{CH}_2)_x-\text{NH}-\text{C}(\text{O})\text{CHR}^7\text{CH}_2$;
15 q is 1-2; m is 1-2; R^7 is hydrogen; t is 1; u is 1-2; n is 2-3;
 x is 2-3.

12. The antimicrobial lens of claim 1 wherein the monomer of Formula I is selected from the group consisting of 1-allyl-2 thiourea and the following monomers

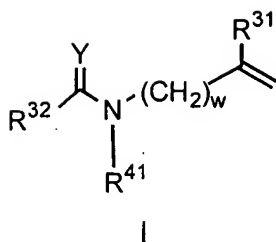


13. The antimicrobial lens of claim 1 wherein silver is present at about 60 ppm to about 4,000 ppm.

14. The antimicrobial lens of claim 1 wherein silver is present at about 60

ppm to about 2,000 ppm.

- 5
15. The antimicrobial lens of claim 1 wherein silver is present at about 60 ppm to about 1,000 ppm.
16. The antimicrobial lens of claim 1 wherein the lens is a silicone hydrogel and the ligand monomer is 1-allyl-2-thiourea.
- 10 17. The antimicrobial lens of claim 16 wherein silver is present at about 60 ppm to about 4000 ppm and the ligand monomer is present at about 0.01 to about 1.5 weight percent.
- 15 18. The antimicrobial lens of claim 1 wherein the lens is etafilcon A, balafilcon, A, aquafilcon A, lenefilcon, galyfilcon, senofilcon or lotrafilcon A and the ligand monomer is 1-allyl-2-thiourea.
- 20 19. The antimicrobial lens of claim 18 wherein silver is present at about 60 ppm to about 2000 ppm and the ligand monomer is present at about 0.01 to about 1.5 weight percent.
- 25 20. The antimicrobial lens of claim 19 wherein the lens is etafilcon A or aquafilcon A.
21. The lens of claim 20 wherein silver is present at about 60 ppm to about 1000 ppm.
22. A method of producing an antimicrobial lens comprising, silver and a polymer comprising at least one ligand monomer of Formula I



5 wherein

w is 0-1;

Y is oxygen or sulfur;

R³¹ is hydrogen or C₁₋₆alkyl;

R³² is selected from the group consisting of hydroxyl, amino, sulfonic
 10 acid, phosphonic acid, carboxylic acid, thioC₁₋₆alkylcarbonyl,
 thioC₁₋₆alkylaminocarbonyl, -C(O)NH-(CH₂)_d-R³³, -O-R³³, -NH-R³³,
 -S-(CH₂)_d-R³³, -(CH₂)_d-R³³, C₁₋₆alkyldisulfide, phenyldisulfide, urea,
 C₁₋₆alkylurea, phenylurea, thiourea, C₁₋₆alkylthiourea, phenylthiourea,
 C₁₋₆alkylamine, phenylamine, substituted C₁₋₆alkyldisulfide, substituted
 15 phenyldisulfide, substituted phenylurea, substituted C₁₋₆alkylamine,
 substituted phenylamine, substituted phenylthiourea, substituted
 C₁₋₆alkylurea or substituted C₁₋₆alkylthiourea wherein the substituents
 are selected from the group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl,
 halogen, hydroxyl, carboxylic acid, sulfonic acid, phosphonic acid,
 20 amine, amidine, acetamide, and nitrile

where

d is 0-8;

R³³ is thioC₁₋₆alkylcarbonyl, C₁₋₆alkyl, substituted C₁₋₆alkyl

where the alkyl substituents are selected from
 25 one or more members of the group consisting of
 C₁₋₆alkyl, halo C₁₋₆alkyl, halogen, hydroxyl,
 carboxylic acid, sulfonic acid, phosphonic acid,
 amine, amidine, acetamide, nitrile, thiol,

C₁₋₆alkyldisulfide, C₁₋₆alkylsulfide, phenyldisulfide,
 urea, C₁₋₆alkylurea, phenylurea, thiourea,
 C₁₋₆alkylthiourea, phenylthiourea, substituted
 C₁₋₆alkyldisulfide, substituted phenyldisulfide,
 substituted C₁₋₆alkylurea, substituted phenylurea,
 substituted C₁₋₆alkylthiourea or substituted
 phenylthiourea
 wherein the C₁₋₆alkyldisulfide, phenyldisulfide,
 C₁₋₆alkylurea, C₁₋₆alkylthiourea, phenylurea, and
 phenylthiourea substituents are selected from the
 group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl,
 halogen, hydroxyl, carboxylic acid, sulfonic acid,
 phosphonic acid, amine, amidine, acetamide, and
 nitrile;
 $-(CR^{34}R^{35})_q-(CHR^{36})_m-SO_3H$
 where R³⁴, R³⁵, and R³⁶ are independently selected
 from the group consisting of hydrogen, halogen,
 hydroxyl, and C₁₋₆alkyl,
 q is 1-6, and m is 0-6;
 $-(CH_2)_n-S-S-(CH_2)_x-NH-C(O)CR^{37}CH_2$,
 where R³⁷ is hydrogen or C₁₋₆alkyl,
 n is 1-6, and x is 1-6;
 $-(CR^{38}R^{39})_t-(CHR^{40})_u-P(O)(OH)_2$
 where R³⁸, R³⁹, and R⁴⁰ are independently selected
 from the group consisting of hydrogen, halogen,
 hydroxyl, and C₁₋₆alkyl,
 t is 1-6, and
 u is 0-6;
 phenyl, benzyl, pyridinyl, pyrimidinyl, pyrazinyl,
 benzimidazolyl, benzothiazolyl, benzotriazolyl, naphthaloyl,
 quinolinyl, indolyl, thiadiazolyl, triazolyl,

4-methylpiperidin-1-yl, 4-methylpiperazin-1-yl,
substituted phenyl, substituted benzyl,
substituted pyridinyl, substituted pyrimidinyl,
substituted pyrazinyl, substituted benzimidazolyl,
substituted benzothiazolyl, substituted benzotriazolyl,
substituted naphthaloyl, substituted quinolinyl,
substituted indolyl, substituted thiadiazolyl,
substituted triazolyl, substituted 4-methylpiperidin-1-yl, or
substituted 4-methylpiperazin-1-yl,
wherein the substituents are selected from one or more
members of the group consisting of C₁₋₆alkyl,
haloC₁₋₆alkyl, halogen, sulfonic acid, phosphonic acid,
hydroxyl, carboxylic acid, amine, amidine,
N-(2-aminopyrimidine)sulfonyl,
N-(aminopyridine)sulfonyl, N-(aminopyrazine)sulfonyl,
N-(2-aminopyrimidine)carbonyl,
N-(aminopyridine)carbonyl, N-(aminopyrazine)carbonyl,
N-(2-aminopyrimidine)phosphonyl,
N-(2-aminopyridine)phosphonyl,
N-(aminopyrazine)phosphonyl,
N-(aminobenzimidazolyl)sulfonyl,
N-(aminobenzothiazolyl)sulfonyl,
N-(aminobenzotriazolyl)sulfonyl,
N-(aminoindolyl)sulfonyl, N-(aminothiazolyl)sulfonyl,
N-(aminotriazolyl)sulfonyl,
N-(amino-4-methylpiperidinyl)sulfonyl,
N-(amino-4-methylpiperazinyl)sulfonyl,
N-(aminobenzimidazolyl)carbonyl,
N-(aminobenzothiazolyl)carbonyl,
N-(aminobenzotriazolyl)carbonyl,
N-(aminoindolyl)carbonyl, N-(aminothiazolyl)carbonyl,

N-(aminotriazolyl)carbonyl,
 N-(amino-4-methylpiperidiny)carbonyl,
 N-(amino-4-methylpiperaziny)carbonyl,
 N-(2-aminobenzimidazolyl)phosphonyl,
 5 N-(2-aminobenzothiazolyl)phosphonyl,
 N-(2-aminobenzotriazolyl)phosphonyl,
 N-(2-aminoindolyl)phosphonyl,
 N-(2-aminothiazolyl)phosphonyl,
 N-(2-aminotriazolyl)phosphonyl,
 10 N-(amino-4-methylpiperidiny) phosphonyl,
 N-(amino-4-methylpiperaziny) phosphonyl, acetamide,
 nitrile, thiol, C₁₋₆alkyldisulfide, C₁₋₆alkylsulfide, phenyl
 disulfide, urea, C₁₋₆alkylurea, phenylurea, thiourea,
 C₁₋₆alkylthiourea, phenylthiourea, substituted
 15 C₁₋₆alkyldisulfide, substituted phenyldisulfide,
 substituted C₁₋₆alkylurea, substituted C₁₋₆alkylthiourea,
 substituted phenylurea, and substituted phenylthiourea
 wherein the C₁₋₆alkyldisulfide, phenyldisulfide,
 C₁₋₆alkylurea, C₁₋₆alkylthiourea, phenylurea, and
 20 phenylthiourea substituents are selected from the
 group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl, halogen,
 hydroxyl, carboxylic acid, sulfonic acid, phosphonic
 acid, amine, amidine, acetamide, and nitrile;
 R⁴¹ is selected from the group consisting of hydrogen, C₁₋₆alkyl,
 25 phenyl, C₁₋₆alkylcarbonyl, phenylcarbonyl, substituted C₁₋₆alkyl,
 substituted phenyl, substituted C₁₋₆alkylcarbonyl and substituted
 phenylcarbonyl,
 wherein
 the substituents are selected from the group consisting of
 30 C₁₋₆alkyl, haloC₁₋₆alkyl, halogen, hydroxyl, carboxylic acid,
 sulfonic acid, phosphonic acid, amine, amidine, acetamide,

and nitrile

where the method comprises the steps of

(a) preparing a lens comprising at least one ligand monomer and

(b) treating the lens with a silver solution of a concentration to

5 provide the lens with a silver to ligand monomer ratio of at least
about 0.6.

23. The method of claim 22 wherein the silver solution is aqueous silver
nitrate having a concentration of about 0.1 µg/mL to about 0.3 g/mL.

10 24. The method of claim 22 wherein, the treating step comprises soaking
the lens in the silver solution.

25. The method of claim 24 wherein, the lens is soaked in the silver solution
15 for about 2 minutes to about 2 hours.

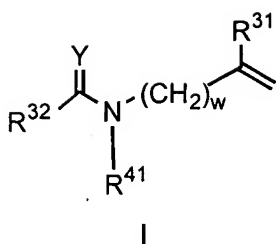
26. The method of claim 22 wherein, the treating step comprises storing the
lens in a silver solution for about 20 minutes to about 5 years.

20 27. The method of claim 22 wherein the ratio of silver to ligand monomer is
at least about 0.8.

28. The lens of claim 1 wherein said lens displays at least about a 0.4 log
reduction in microbial activity.

25 29. The lens of claim 1 wherein said lens displays at least about a 1 log
reduction in microbial activity..

30 30. A lens case comprising silver and a polymer comprising at least one
ligand monomer of Formula I
of Formula I



5

wherein

w is 0-1;

Y is oxygen or sulfur;

R³¹ is hydrogen or C₁₋₆alkyl;

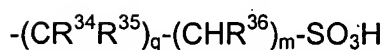
10 R³² is selected from the group consisting of hydroxyl, amino, sulfonic acid, phosphonic acid, carboxylic acid, thioC₁₋₆alkylcarbonyl, thioC₁₋₆alkylaminocarbonyl, -C(O)NH-(CH₂)_d-R³³, -O-R³³, -NH-R³³, -S-(CH₂)_d-R³³, -(CH₂)_d-R³³, C₁₋₆alkyldisulfide, phenyldisulfide, urea, C₁₋₆alkylurea, phenylurea, thiourea, C₁₋₆alkylthiourea, phenylthiourea, 15 C₁₋₆alkylamine, phenylamine, substituted C₁₋₆alkyldisulfide, substituted phenyldisulfide, substituted phenylurea, substituted C₁₋₆alkylamine, substituted phenylamine, substituted phenylthiourea, substituted C₁₋₆alkylurea or substituted C₁₋₆alkylthiourea wherein the substituents are selected from the group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl, 20 halogen, hydroxyl, carboxylic acid, sulfonic acid, phosphonic acid, amine, amidine, acetamide, and nitrile

where

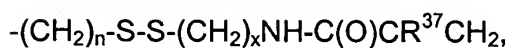
d is 0-8;

25 R³³ is thioC₁₋₆alkylcarbonyl, C₁₋₆alkyl, substituted C₁₋₆alkyl where the alkyl substituents are selected from one or more members of the group consisting of C₁₋₆alkyl, halo C₁₋₆alkyl, halogen, hydroxyl, carboxylic acid, sulfonic acid, phosphonic acid,

amine, amidine, acetamide, nitrile, thiol,
 C₁₋₆alkyldisulfide, C₁₋₆alkylsulfide, phenyldisulfide,
 urea, C₁₋₆alkylurea, phenylurea, thiourea,
 C₁₋₆alkylthiourea, phenylthiourea, substituted
 C₁₋₆alkyldisulfide, substituted phenyldisulfide,
 substituted C₁₋₆alkylurea, substituted phenylurea,
 substituted C₁₋₆alkylthiourea or substituted
 phenylthiourea
 wherein the C₁₋₆alkyldisulfide, phenyldisulfide,
 C₁₋₆alkylurea, C₁₋₆alkylthiourea, phenylurea, and
 phenylthiourea substituents are selected from the
 group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl,
 halogen, hydroxyl, carboxylic acid, sulfonic acid,
 phosphonic acid, amine, amidine, acetamide, and
 nitrile;



where R³⁴, R³⁵, and R³⁶ are independently selected
 from the group consisting of hydrogen, halogen,
 hydroxyl, and C₁₋₆alkyl,
 q is 1-6, and m is 0-6;



where R³⁷ is hydrogen or C₁₋₆alkyl,
 n is 1-6, and x is 1-6;



where R³⁸, R³⁹, and R⁴⁰ are independently selected
 from the group consisting of hydrogen, halogen,
 hydroxyl, and C₁₋₆alkyl,
 t is 1-6, and
 u is 0-6;

phenyl, benzyl, pyridinyl, pyrimidinyl, pyrazinyl,
 benzimidazolyl, benzothiazolyl, benzotriazolyl, naphthaloyl,

quinoliny, indoly, thiadiazoly, triazoly,
4-methylpiperidin-1-yl, 4-methylpiperazin-1-yl,
substituted phenyl, substituted benzyl,
substituted pyridiny, substituted pyrimidiny,
5 substituted pyraziny, substituted benzimidazoly,
substituted benzothiazoly, substituted benzotriazoly,
substituted naphthaloyl, substituted quinoliny,
substituted indoly, substituted thiadiazoly,
substituted triazoly, substituted 4-methylpiperidin-1-yl, or
10 substituted 4-methylpiperazin-1-yl,
wherein the substituents are selected from one or more
members of the group consisting of C₁₋₆alkyl,
haloC₁₋₆alkyl, halogen, sulfonic acid, phosphonic acid,
hydroxyl, carboxylic acid, amine, amidine,
15 N-(2-aminopyrimidine)sulfonyl,
N-(aminopyridine)sulfonyl, N-(aminopyrazine)sulfonyl,
N-(2-aminopyrimidine)carbonyl,
N-(aminopyridine)carbonyl, N-(aminopyrazine)carbonyl,
N-(2-aminopyrimidine)phosphonyl,
20 N-(2-aminopyridine)phosphonyl,
N-(aminopyrazine)phosphonyl,
N-(aminobenzimidazoly)sulfonyl,
N-(aminobenzothiazoly)sulfonyl,
N-(aminobenzotriazoly)sulfonyl,
25 N-(aminoindoly)sulfonyl, N-(aminothiazoly)sulfonyl,
N-(aminotriazoly)sulfonyl,
N-(amino-4-methylpiperidiny)sulfonyl,
N-(amino-4-methylpiperaziny)sulfonyl,
N-(aminobenzimidazoly)carbonyl,
30 N-(aminobenzothiazoly)carbonyl,
N-(aminobenzotriazoly)carbonyl,

N-(aminoindolyl)carbonyl, N-(aminothiazolyl)carbonyl,
 N-(aminotriazolyl)carbonyl,
 N-(amino-4-methylpiperidiny)carbonyl,
 N-(amino-4-methylpiperaziny)carbonyl,
 N-(2-aminobenzimidazolyl)phosphonyl,
 N-(2-aminobenzothiazolyl)phosphonyl,
 N-(2-aminobenzotriazolyl)phosphonyl,
 N-(2-aminoindolyl)phosphonyl,
 N-(2-aminothiazolyl)phosphonyl,
 N-(2-aminotriazolyl)phosphonyl,
 N-(amino-4-methylpiperidiny) phosphonyl,
 N-(amino-4-methylpiperaziny) phosphonyl, acetamide,
 nitrile, thiol, C₁₋₆alkyldisulfide, C₁₋₆alkylsulfide, phenyl
 disulfide, urea, C₁₋₆alkylurea, phenylurea, thiourea,
 C₁₋₆alkylthiourea, phenylthiourea, substituted
 C₁₋₆alkyldisulfide, substituted phenyldisulfide,
 substituted C₁₋₆alkylurea, substituted C₁₋₆alkylthiourea,
 substituted phenylurea, and substituted phenylthiourea
 wherein the C₁₋₆alkyldisulfide, phenyldisulfide,
 C₁₋₆alkylurea, C₁₋₆alkylthiourea, phenylurea, and
 phenylthiourea substituents are selected from the
 group consisting of C₁₋₆alkyl, haloC₁₋₆alkyl, halogen,
 hydroxyl, carboxylic acid, sulfonic acid, phosphonic
 acid, amine, amidine, acetamide, and nitrile;
 R⁴¹ is selected from the group consisting of hydrogen, C₁₋₆alkyl,
 phenyl, C₁₋₆alkylcarbonyl, phenylcarbonyl, substituted C₁₋₆alkyl,
 substituted phenyl, substituted C₁₋₆alkylcarbonyl and substituted
 phenylcarbonyl,
 wherein
 the substituents are selected from the group consisting of
 C₁₋₆alkyl, haloC₁₋₆alkyl, halogen, hydroxyl, carboxylic acid,

sulfonic acid, phosphonic acid, amine, amidine, acetamide,
and nitrile.